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TECHNICAL SERIES, NO. 24.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

THE LIFE HISTORY OF THE ALDER BLIGHT APHIS.

BY

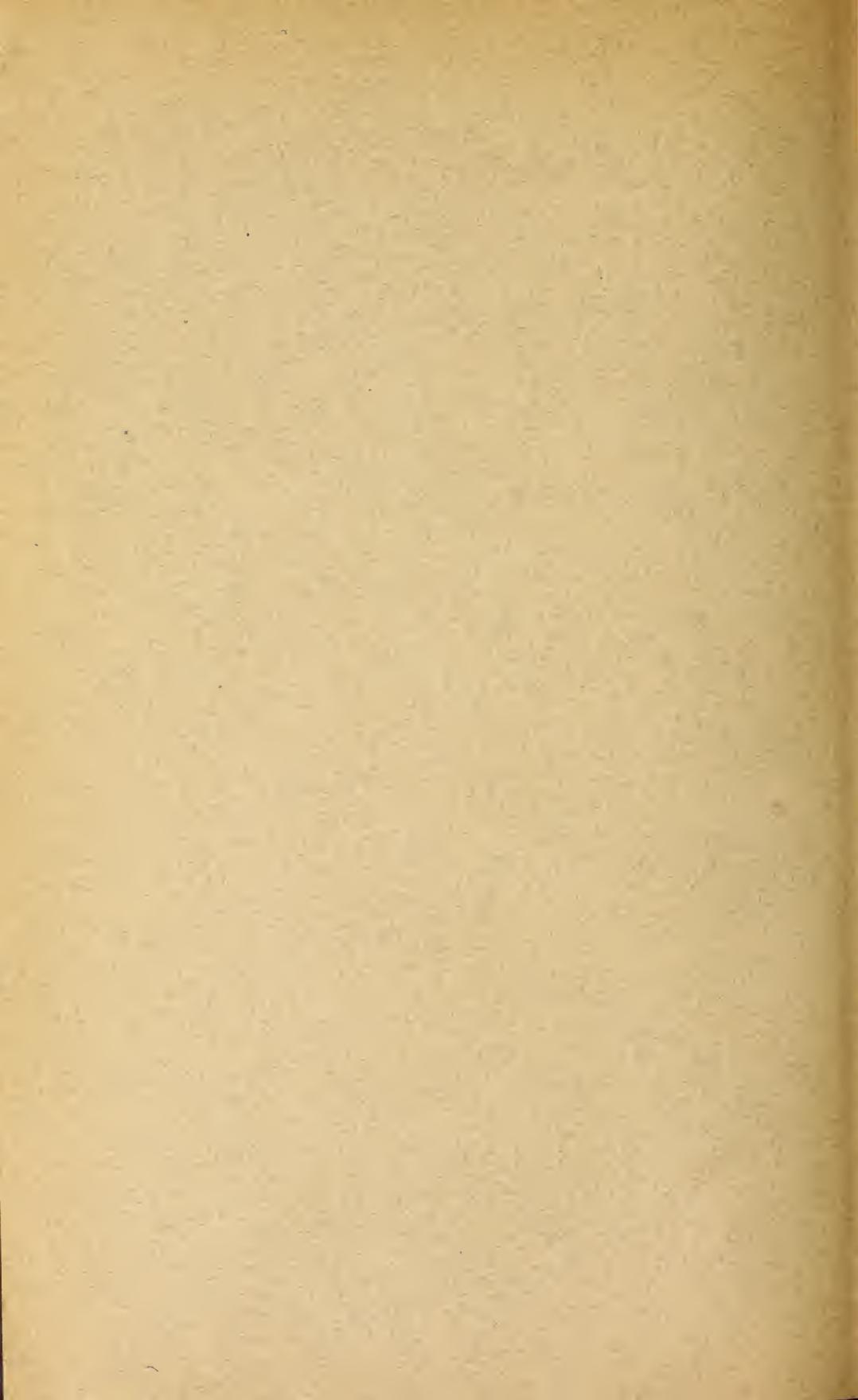
THEO. PERGANDE,

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ISSUED APRIL 29, 1912.



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L. O. HOWARD, *Entomologist and Chief of Bureau.*

C. L. MARLATT, *Entomologist and Acting Chief in Absence of Chief.*

R. S. CLIFTON, *Executive Assistant.*

W. F. TASTET, *Chief Clerk.*

F. H. CHITTENDEN, *in charge of truck crop and stored product insect investigations.*

A. D. HOPKINS, *in charge of forest insect investigations.*

W. D. HUNTER, *in charge of southern field crop insect investigations.*

F. M. WEBSTER, *in charge of cereal and forage insect investigations.*

A. L. QUAINSTANCE, *in charge of deciduous fruit insect investigations.*

E. F. PHILLIPS, *in charge of bee culture.*

D. M. ROGERS, *in charge of preventing spread of moths, field work.*

ROLLA P. CURRIE, *in charge of editorial work.*

MABEL COLCORD, *in charge of library.*

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THE LIFE HISTORY OF THE ALDER BLIGHT APHIS.

INTRODUCTION.

For many years past the writer has spent much time in studying the insects of the family Aphididae, or plant-lice, in the office and laboratory and in the field. In perhaps no other group of insects is a thorough knowledge of the life histories so necessary to correct conceptions of the species and the differences between them. These life-history studies are often rendered especially difficult from the well-known fact that many of these aphides have a secondary or alternate food plant. In the case of injurious species it sometimes happens that the main injury is to the alternate food plant, and the discovery of the primary food plant furnishes the key to the most effective way of controlling the species. A notable example of this is the hop aphis (*Phorodon humuli* Schrank) which lays its eggs and passes the winter on the plum, and which is best combated by destroying or spraying the wild or cultivated plum trees at the seasons of the year when the aphis is present on this food plant, rather than by measures directed against the insect during the summer when it occurs on the hopvines.

The writer has worked out the life histories of several of the aphides which have alternate food plants. Among these may be mentioned *Hormaphis hamamelidis* Fitch and *Hamamelistes spinosus* Shimer, which inhabit both the witch-hazel and the birch,¹ the hop aphis, just mentioned, and others.

Investigations by the writer of the present species, which has heretofore been confused under various names, were begun in 1878 and have been continued up to the year 1911. They have resulted in straightening out the synonymy of the species and furnished conclusive proof that the *Pemphigus acerifolii* of Riley, described from the maple, and the (*Eriosoma*) *Pemphigus tessellata* of Fitch, described from the alder, are merely forms or series of one and the same species, which should now be known as *Prociphilus tessellata* (Fitch).

¹ Tech. Ser. No. 9, Div. Ent., U. S. Dept. Agr., 1901.

GENERIC AND SPECIFIC SYNONYMY OF PROCIPHILUS TESSELLATA FITCH.

Eriosoma tessellata Fitch, Cat. Ins. [N. Y.] State Cab. Nat. Hist., p. 68, 1851.

Aphis stamineus Haldeman, Proc. Boston Soc. Nat. Hist., vol. 6, p. 403, 1859.

Schizoneura tessellata Thomas, 8th Rept. Nox. and Ben. Ins. Ill., p. 139, 1879.

Pemphigus tessellata Osborn, Can. Ent., vol. 14, p. 61, 1882.

Pemphigus acerifolii Riley, 8th Rept. Nox. and Ben. Ins. Ill., Suppl., p. 209, 1879.

Pemphigus alni Provancher, Petite Faune Entomologique du Canada, vol. 3, p. 320, 1886.

PROCIPHILUS Koch.

The genus *Prociphilus* was described by C. L. Koch¹ in 1857, and included three species. The following is a translation of his generic diagnosis:

"*Antennæ*.—Short; the two basal joints as usual, short; joint 3 as long as the two following joints combined and somewhat uneven; joints 4 to 6 subequal in length; spur of sixth joint thin and rather short."

"*Nectaries*.—Wanting."

"*Anterior wings*.—Stigma long and narrow; the stigmal vein slightly curved. The first two discoidal veins arising close together, though not from the same point."

"*Legs*.—Rather stout and long."

All of these characters agree well with those of *P. tessellata* Fitch and some other species.

In connection with the above description it seems necessary to add a few points not mentioned by Koch:

Antennal joints 3 to 5 or 6 more or less densely provided with transverse, elongate-oval sensoria, not reaching the lateral margin.

Venation of hind wings like that of *Pemphigus*; the two discoidal veins arising near each other from the subcostal vein about the middle between the base of the wing and the hooklets, at a point where the subcostal bends suddenly toward the front margin of the wing, giving it the appearance of three discoidal veins or of a three-pronged fork.

Last abdominal segment and tail semicircular and fringed with slender hairs.

PROCIPHILUS TESSELLATA Fitch.

This so common species was first described by Dr. Asa Fitch, State entomologist of the State of New York, from apterous specimens found on branches of alder (*Alnus rubra*), in his catalogue of the Homoptera of the State Cabinet of Natural History of the State of New York, 1851, page 68, with the following words:

¹ "Pflanzenläuse Aphiden," p. 279.

"Alder blight, *E. tessellata*. Dull bluish-black; tergum with the segments marked by strongly impressed lines and covered by white down in square checker-like spots. Length, 0.16. On the underside of branches of the alder (*Alnus rubra*, Marsh.) crowded together and concealed beneath a dense covering of snow-white down. I have searched in vain for winged individuals of this species. No. 863."

A few years later Prof. S. S. Haldeman described the same species¹ as a large species forming follicles on the leaves of the silver-leaved maple, *Acer eriocarpum* (of which *Acer dasycarpum* is but a synonym). He refers to it as follows:

"Aphis (*Pemphigus*) *stamineus*.

"This name is proposed for a large species of *Aphis* which forms follicles on the leaves of the silver-leaved maple (*Acer eriocarpum*)."

Prof. Haldeman, who mistook the migratory female for the male, gave the following description of the insect:

"*Male*.—Black, feet long, slender, and rufous; tarsi biarticulate; wings slightly deflexed, translucent, pale ferruginous at the base, submarginal nervure conspicuous, black, and ending in a long stigma; disk with four simple nervures; posterior wings with three nervures; mesonotum polished, with a deep Y-shaped impression; abdomen without tubes; promuscis obsolete, antennæ 6-articulate, the first two short, the third long, and the fourth, fifth, and sixth gradually lengthening; length of body, 1½ lines, or, to the end of the wings, 2½ lines.

"*Female and pupa*.—Apterous, dark-reddish brown, feet paler; promuscis twice as long as the head, thickened near the apex; length, 1½ lines."

This is without a doubt the same species as the one described by Prof. C. V. Riley under the name of *Pemphigus acerifolii*, the description of which, for the benefit of those interested in this subject, may be here reproduced.

"*Pemphigus acerifolii* Riley.

"Living in abundant and long cottony excretions on the underside of the leaves of *Acer dasycarpum*, causing them to curl, and exuding an abundance of thick and very glutinous 'honey-dew.'

"*Winged female*.—Alar expanse 16 mm. Head and thorax bluish-black. Abdomen black, covered with long cottony threads. Antennæ reaching the wing insertions; annulations not conspicuous; joints 3, 4, 5, and 6 somewhat contracted at base and apex; apical unguis not perceptible; joints 5 and 6 subequal; 4 distinctly clavate; 3 as long as the two preceding together. Wings subhyaline, of a

¹ Proc. Boston Soc. Nat. Hist., vol. 6, p. 403, 1859.

whitish tinge; subcostal vein and the inner margin of the stigma black: oblique veins whitish, stigma short and broad, not angled at the base of the stigmal vein, which starts from a little behind the middle and is comparatively straight, thereby making the apical cell rather narrow. Terminal distances between the veins subequal, that between second discoidal and cubital somewhat greatest; basal one-third of the cubitus hyaline, but not abortive, as it can usually be traced to its base, which is very close to that of the second discoidal; bases of the two discoidals either approximate or quite contiguous; discoidals of the hind wings proceeding connectedly from the subcostal vein. Larva with 5-jointed antennæ and the promuscis extending beyond tip of abdomen."

Prof. Cyrus Thomas determined the alder blight as *Schizoneura tessellata*, and gave the following short note concerning it:

This species is found on the underside of the branches of the alder (*Alnus rubra*), crowded together and concealed beneath a covering of snow-white down. Wingless individuals, dull bluish-black: the back of the segments are marked with strongly impressed lines and covered with white down in square, checker-like spots. Length to tip of the abdomen, 0.16 inch.

Prof. H. Osborn, on account of the simple venation of the wings, referred the species to the genus *Pemphigus*.

Lastly, it was described under the name of *Pemphigus alni* by the Abbé L. Provancher, who supposed that it was a new species. The following is an English translation of the French original description:

Pemphigus of the alder. *Pemphigus alni*.

Length, 0.8 mm.; to the tip of the wings, 22 mm. Dark brown, including the head and legs, covered entirely with a whitish powder. The abdomen is covered with a long, white, and woolly secretion. The wings are transparent, the veins brown and strong; stigma elongated, narrow; radical cell elongate, inferior veins barely curved.

Found in dense, compact masses, several inches long, on *Alnus*, during September.

Besides the above extracts pertaining to this species, it may be appropriate to mention here also a short report by Dr. Peter Kalm, a Swedish naturalist, of whose "Travels into North America" an English translation has been published. In Volume I, second edition (1772), page 121, there is the following account of an insect on the alder, noticed by him while traveling through Pennsylvania and Delaware, October 3, 1748:

I saw to-day the *Chermes* of the alder (*Chermes alni*) in great abundance on the branches of that tree, which for that reason looks quite white, and at a distance appears as it were covered with mould.

The above lines refer undoubtedly to *P. tessellata*, which Kalm mistook for the European insect which was mentioned by Linnæus

in "Fauna Suecica," published in 1746, but which was described in the "Acta" of Upsala in 1736 under the name of *Chermes alni* L. Later, by mistake or oversight, Dr. M. Geoffroy¹ redescribed this latter insect under the name of *Psylla viridis*, and as inhabiting the alder, without recognizing in it the *Chermes alni* L., which may be considered typical of the genus *Psylla*, and a good illustration of which, though without a name, will be found in "Mémoires pour Servir à l'Histoire des Insectes," Volume III (1737), Plate XXVI, figure 1, by M. de Reaumur. Another figure of the same psyllid was published by J. H. Sulzer² under the name of *Chermes alni* L. Evidently this psyllid, from a distance, bears some resemblance to our American insect *P. tessellata*, which inhabits the American alders.

Kalm was therefore greatly mistaken when he supposed that our insect was the same as the European *Chermes alni* L., or rather, as it is now known, *Psylla alni*.

Ratzeburg³ refers to this insect in the following words:

Auf Erlen [alders], ist die im Puppenzustande sehr sonderbare, kurzborstige, grüne, zuletzt schwarzaftrige, als Fliege, schön grassgrüne $1\frac{1}{4}'''$ lange *P. alni* L., welche meist in der Blattachsel ihren Sitz hat, sehr, ausgezeichnet durch lange weisse Wolle, welche beweglich zu werden scheint, wenn das Insect beunruhigt wird.

An English translation of the above would read as follows:

On the alders are found very curious, green, short-spined pupæ, the anal end of which in time becomes quite black, which eventually change into the $1\frac{1}{4}$ lines long, bright, grass-green *Psylla alni* L. They are generally stationed in the angles formed by junctions of the petioles of the leaves and the twigs. The most obvious characteristic about them is the very long, white wool, which appears to move whenever the insect is irritated.

All of the above facts prove that the European *Chermes* or *Psylla alni* L. has nothing in common with the American insect.

FIRST SERIES: PEMPHIGUS ACERIFOLII RILEY.

Observations on the first or original series of *Pemphigus acerifolii* Riley, inhabiting the soft, or silver maple, *Acer dasycarpum*, were commenced by me in 1878 and continued until the year 1911, whereas observations on the alternating, or second series, of *Pemphigus tessellata* Fitch, inhabiting the alders, were started in 1883, or about five years later than those of the former.

Pemphigus acerifolii issues during the early or middle part of April, or as soon as the young leaves appear, from winter eggs deposited the previous fall in cracks or under loose bark on the trunks

¹ Histoire Abrégée des Insectes, vol. 1, p. 486, no. 3, 1799.

² Die Kennzeichen der Insekten, Pl. XII, 1761.

³ Die Forst-Insecten, vol. 3, p. 187, 1844,

of maples, on which return migrants from alders had delivered themselves of the true sexes.

These young stem-mothers, after hatching from winter eggs, travel upward onto the branches and settle on the midrib of the underside of the young leaflets. Usually there is but 1, though frequently there may be 2, 3, or more on the same leaf, in consequence of which, as well as from the increasing irritation, the leaves thus infested exhibit a more or less marked tendency to fold or almost to "double up" from the midrib downward.

Under or within this protection or covering there may be observed numbers of larvæ and pupæ of different stages, up to 100 or more, in company with their mother, all of which, from early in June to the end of July, or until the supply for migrants has been exhausted, develop into winged migrants, without, however, leaving any larvæ behind to continue the series on the maple. These migrants fly then to the alders, which frequently are rather distant from the maples, and settle at once on the underside of the leaves of these shrubs, where they are soon engaged in depositing their larvæ, which surround them in a circle of about 20 to 100. These larvæ, after feeding for about an hour or so, move to the twigs, branches, or stems of the shrubs to start a new cycle of life for the species. Here a number of generations is developed, after which, from about the middle of September to the middle of October, numerous return migrants are developed, which fly back to the trunks of the maples to continue the cycle of life prescribed by nature.

In consequence of these facts, which were gradually obtained, I have been able to prove beyond a doubt that the original host plant of this species is the silver maple, and not, as might be supposed, the alder; the latter is its secondary food plant, and proof of this was established during June of 1903.

In conjunction with the above, it seems proper and just to give some of the observations made through which the life history of the species was definitely ascertained.

Besides the migrants from the maple and return migrants from the alder, I ascertained also that after the departure of the return migrants numbers of mature, apterous females still remain upon the alders and keep on producing additional larvæ, all of which, without casting a skin, crawl down the stems, and frequently to the stouter roots, which are more or less surrounded by cavities made by ants, or hide between or beneath the dead leaves, etc., which surround the base of the shrubs, for hibernation. These form the first hibernating series of larvæ and neither feed nor grow until the sap rises again the following spring, when, after an absorption of sufficient nourishment, they cast their first skin and keep on growing until mature, at which time,

like their parents, they also deposit numbers of larvæ, which in turn reach maturity.

Multiplication goes on in this way until a second series of migrants is produced the following fall from the original settlers. However, there remain again enough apterous females to produce a second series of hibernating larvæ, to produce an additional series of migrants. A third series of migrants and hibernating larvæ was also traced.

How long the vitality of the original stock will last it is impossible at present to surmise, though it seems that multiplication may go on indefinitely if the aphides are not exterminated by carnivorous enemies or by parasites.

The most active among the carnivorous enemies are the larvæ of the lycænid butterfly *Feniseca tarquinius* Fabricius; the larvæ of the lacewing fly *Chrysopa sicheli* Fitch [=*C. quadripunctata* Burmeister]; the larvæ and imagos of two ladybirds, *Hippodamia convergens* Guérin, and *Adalia bipunctata* Linnaeus; the larvæ and imagos of a hemipteron, (*Nabis*) *Pagasa fusca* Stein, besides the larvæ of various syrphid flies, which generally prove very destructive to these aphides and frequently exterminate whole colonies.

Internal parasites are thus far not known.

Besides these enemies, there are various species of ants which are mainly attracted to these aphides by the honeydew ejected by them, upon which they feed, while some of them even protect the aphides against enemies by constructing tubes or tunnels of earth over and around such colonies, leaving here and there a few exits open to enable the ants to enter and leave. The ants which have been observed to construct tunnels or covers over these aphides are *Tapinoma sessile* Say and *Cremastogaster lineolata* Say; among those which simply gather honeydew, *Camponotus pennsylvanicus* De Geer, *Lasius alienus* Förster, and *Monomorium minimum* Buckley (*minutum* Mayr) have been observed.

EXTRACTS FROM NOTES MADE AT THE TIME.

June 28, 1883.—Migrants from maple leaves, placed in a jar for observation, deposited since yesterday a large number of larvæ. All of them were provided with a long rostrum, which proved that they were not the sexes of this species.

Found to-day two colonies on leaves of maple near Rosslyn, Va., and considered the migrants in these colonies at that time as being identical with those of *Pemphigus tessellata* Fitch, though notwithstanding that migrants were flying, I failed to observe any of them or their larvæ on any of the alders examined. However, after placing infested leaves of maple with a branch of alder I found, later on, that two of the migrants had settled on the alder leaves.

With them were also a few small colonies of larvæ which had settled on the branch, while recently deposited larvæ were also observed on the leaves.

June 7, 1904.—Received to-day from Chatham, Va., some leaves of maple infested with pupæ and migrants of *Pemphigus acerifolii*. A number of these migrants were placed with a potted plant of alder for observation, and I found the following day that quite a number of these migrants had settled on the underside of some of the leaves, and with them were many young larvæ which they had deposited, all of which proved them to be identical in every respect with those

of *Prociphilus tessellata*. These larvæ were reddish or brownish red and provided at the anal end of the body with a white and curly or cottony secretion, which gradually spread over the whole insect until it had the appearance of a little lump of cotton.

Migrants which were placed with a potted maple died without depositing any larvæ.

June 23, 1905.—Observed to-day some migrants of *Pemphigus acerifolii*, on the underside of leaves of alders, *Alnus rugosa*, near the Chain Bridge, District of Columbia. They were each surrounded by a circle of about 28 larvæ, all of which had already cast their first skin, which was adhering to the leaves. These larvæ were orange and their abdomen covered with a long

and backward-directed, cottony secretion, whereas that of the thorax was shorter and quite erect, longest along the median line. Sometimes three or four of the migrants had settled on the same leaf; some of them were already dead or barely living. On some of the leaves were several rings of cast skins, varying from 18 to 40 in number, while on the branches of the same shrubs were numerous larger or smaller colonies of larvæ.

April 11, 1905.—While examining trunks of maples near Rosslyn, Va., I found, under the shaggy bark of a tree, numbers of dead and dry return migrants, and with them also some of the young stem-

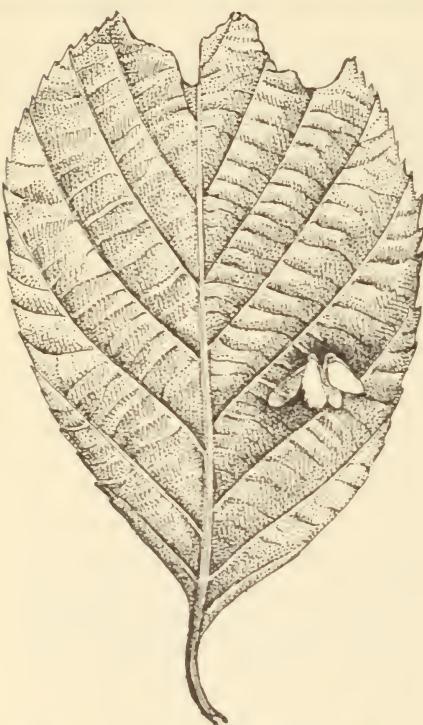


FIG. 1.—*Prociphilus tessellata*; Migrants from maple to alder. (Original.)

mothers, slowly moving about, all of which would have had to crawl 5 to 10 feet to reach the nearest branches. Young larvae were not yet present, though the buds were just swelling.

May 11, 1906.—To-day I saw near Rosslyn, Va., a few young stem-mothers on leaves of lower branches of maples stationed near the base of the midrib on the underside of the leaves. Two of them were already fully grown and completely covered with a large amount of woolly secretion, irregularly interspersed with rather long and more or less curly or wavy white threads. These two females deposited a few larvae till the day following.

May 18, 1906.—Found at Rosslyn, in the same locality as above, six of the stem-mothers on one of the maples. With one of them were 75 and with another one over 100 larvae, which were already of two stages and of a pale orange color. The smaller larvae had a brush of white secretions at the end of the body, whereas the whole dorsum of the larger or older larvae was covered with long, white wool, interspersed with twine-like, wavy strands.

June 6, 1906.—A lot of maple leaves badly infested with *Pemphigus acerifolii* were received to-day from Fredericksburg, Va. Among the aphides were quite a number of migrants, some of which were placed on leaves of a potted alder and soon settled on the underside of these leaves. On examining this tree in the afternoon of the next day I found that one of the migrants had deposited a considerable number of larvae, which soon after were seen traveling up and down the stem.

June 10, 1906.—Discovered to-day four colonies of *Pemphigus acerifolii* on leaves of maple near the Chain Bridge, District of Columbia. The infested leaves were almost folded, both halves bending down from the midrib. Inside of these folds were numbers of pupae which at the anal end were provided with about 12 rather stout, twine-like, and somewhat wavy or curly white filaments, about 3 or 4 times the length of the body, spreading out fanlike, intermixed at their bases with shorter, fine wool or secretion. In the immediate neighborhood numbers of migrants were already found on the leaves of alders accompanied by a brood of their larvae, besides numerous colonies of larvae on branches and stems.

June 18, 1906.—A large colony of larvae from migrants of *Pemphigus acerifolii*, which had settled on the stem of a potted alder, was greatly reduced by pupae of (*Nabis*) *Pagasa fusca* Stein, which fed on the aphides.

June 26, 1906.—Observed to-day numbers of migrants from maple on the underside of leaves of alders near the Chain Bridge, District of Columbia. Many of them were already dead, though all others, still living, were empty and shrunken. Two of the migrants, alive and active, were surrounded by numerous larvae, and still depositing.

There were also numerous colonies of young larvæ on the branches and stems.

May 28, 1911.—Found to-day one colony of *Pemphigus acerifoliij* on a leaf of maple near Rosslyn, Va., containing one stem-mother and 135 of her progeny—mostly pupæ, in various stages of development—besides many quite small larvæ, while the mother appeared to be in a condition to deposit still more.

SECOND SERIES: PEMPHIGUS TESSELLATA FITCH.

Notwithstanding that the insect under this name had been known to me since 1869 as having a range from Canada to Florida and as far west as St. Louis, Mo., occurring upon native and foreign species of alders, the first attempt to learn its life history was begun in June, 1883, when young colonies had established themselves on branches of different kinds of alders on the grounds of the Department of Agriculture at Washington, D. C. The larvæ were apparently the progeny of migrants from maples nearby. They had settled on the underside of the branches in groups of 4 to 8 specimens, arranged in circles, with their heads toward the center. All were covered with rather long, white secretion, so as to resemble a rosette, or a single insect, reminding one strongly of some of the aleyrodids. This secretion issues from 6 rows of transversely oval and rather flat warts.

Early in October of the same year some of the branches were almost completely covered with colonies 12 or more inches in length. Among the great number of apterous females were also many pupæ and large numbers of winged specimens.

EXTRACTS FROM NOTES MADE AT THE TIME.

April 28, 1897.—Observed again small colonies of larvæ on alders on the Agricultural grounds. All of them were densely covered with a white and woolly secretion, intermixed with stout and curly threads. They were closely packed and resembled colonies of large mealy-bugs, arranged more or less in circles; sometimes they were, however, so much crowded that many were actually standing on their heads. These larvæ had apparently been hibernating since the previous fall.

September 12, 1897.—Found large colonies of this insect on alders at Cabin John, Md., and among them numerous pupæ and migrants. The winged specimens were densely covered with long, white tufts of secretion, which formed a dense mass on the dorsum and around the end of the body, besides projecting in shaggy tufts above the closed wings. This secretion was intermixed at the anal end of the body with longer and stouter threads; along the sides of the abdomen were rather long, delicate, and somewhat curly, erect tufts or streamers, and also long and forwardly directed tufts on the thorax

and head, whereas the ventral side of the body was densely covered with a short and white secretion.

September 14, 1897.—A lot of migrants from alders were placed in a tube to obtain their progeny. By the following day they had deposited a number of larvæ which, on examination, proved to be the sexes, or males and females, of this species, both of them without a rostrum. The females were about twice as large as the males and of a bright yellow, whereas the males were greenish or greenish yellow. The antennæ and legs of both were colorless. Each of the females contained only one egg.

Most of the males were dead about 7 days later, whereas most of the females were still alive, active, and mature. These females had cast four skins, which in most cases were still attached, in a continuous string, to the end of the body. None of the females had increased in size, and they looked the same as before. Some had secreted a quantity of rather long and woolly secretion, which covered the posterior half of the body.

September 21, 1897.—On examining the trunks of maples near Rosslyn, Va., I discovered one of the sexual females in a crack of the bark, in the company of a migrant from alder.

September 30, 1897.—Examined the trunk of a European alder on the Agricultural grounds, the branches of which were still covered with this insect; on the trunk were also a few migrants, though I failed to find any of the sexes or the winter eggs; there were, however, on the rough bark and tucked away in cracks or cavities large numbers of hibernating larvæ, while others were still coming down.

November 8, 1897.—Reexamined the same tree, and found again numerous hibernating larvæ in cracks and in empty egg-cases of spiders, but none of the sexes or winter eggs; these larvæ were either covered with a bluish-white secretion or ornamented with 6 dorsal rows of squarish, mealy patches, giving them a pretty, checkered appearance.

After an unavoidable intermission of a number of years, observations on this particular aphis were again taken up in 1903.

January 11, 1903.—While again examining alders on the Agricultural grounds, large numbers of colonies of this species were seen on the shoots, all of them being covered with cottony secretion. On examining these colonies it was found that all of the apterous females were dead, having evidently been killed by the late frosts, but underneath them, and between, were found live and active hibernating larvæ, which evidently had been protected against the wintry blasts by the covering of their dead mothers.

September 27, 1905.—A few colonies on alder were found near the Chain Bridge, District of Columbia, and among them numbers of return migrants.

October 5, 1905.—Large numbers of return migrants were found on the trunks of many of the maples near Rosslyn, Va., while on alders near by some colonies of *Pemphigus tessellata*, composed of apterous females, accompanied by numerous larvae of the hibernating series and numbers of return migrants, were observed. A comparison of these migrants with those found at the same time on the trunks of maples, or with those of the first series, termed *Pemphigus acerifolii*, proved them to be absolutely alike. These return migrants to the maples were scattered over the trunks of the trees from the bottom

to at least 50 feet above the ground, or as far up as the eye could reach, resembling flakes of snow. Frequently as many as 20 or more were counted in some of these batches.

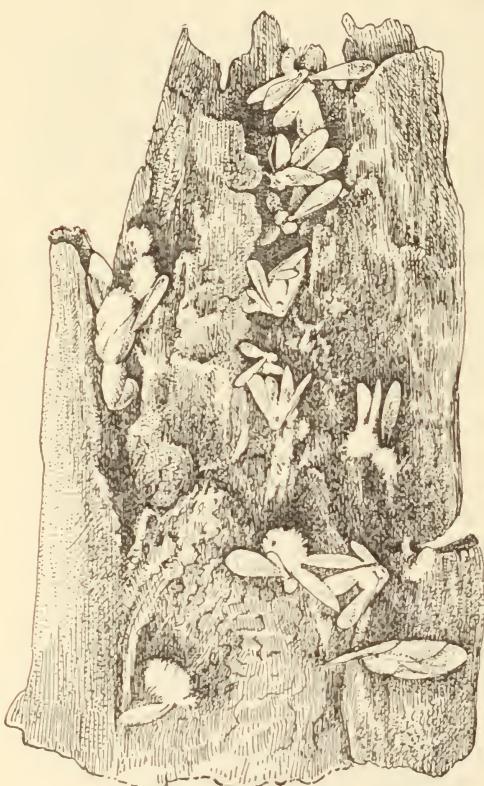


FIG. 2.—*Prociphilus tessellata*: Return migrants on trunk of maple. (Original.)

empty females were colorless and generally died some distance from their egg, though sometimes a dead female was found with the egg still attached to it.

July 19, 1906.—Near the Chain Bridge, District of Columbia. Failed to find *Pemphigus acerifolii* on leaves of maple, nor were any migrants observed on leaves of alders. I discovered, however, 3 colonies of the hibernating series, some of which were already mature females, accompanied by hundreds of young larvae, distributed in patches of 5 to 10 or more, all arranged in circles, with their

With the migrants were also numbers of the true sexes, many of them in copula. Some of these females had crowded into such small cracks that it seemed almost impossible for them to do so; 34 specimens of both sexes were found between and under some old spider webs, while near them under a small piece of loose bark were 110 of the sexual females, closely packed. There were also winter eggs in groups of two or more, slightly covered with or embedded in a delicate layer of white wool. The

heads directed toward the center, each specimen being ornamented with six rows of shaggy or threadlike secretion.

October 15, 1906.—After examining thousands of alders near the Chain Bridge, District of Columbia, only three colonies were discovered, composed of apterous females and their larvæ situated near the surface of the ground on the stems, each of which was completely covered with a tube of mud constructed by the small ant *Tapinoma sessile* Say. I saw, however, on the trunks of large maples, thousands of dead return migrants and the sexual generation belonging to them.

November 26, 1907.—Observed again near the Chain Bridge numbers of hibernating larvæ between the dead and decaying leaves which had accumulated around the base of a small shrub. All of them were quite lively, though not feeding. They were very dark greenish or almost black, covered with a mealy secretion, and provided with a cotton-like brush at the anal end of the body.

March 11, 1908.—Numbers of hibernating larvæ were found near Somerset, Md., which had gathered around the base of the shrubs, though still covered with fallen leaves, while smaller colonies had already settled from 1 to 4 feet above the ground, arranged in circles of 5 to 10 specimens. All were covered with a bluish-white secretion and had 4 dorsal rows of small dense and rounded white knobs and a fringe of woolly secretion along the sides and around the anal end of the body.

May 14, 1908.—Found again near Somerset one small colony, about 2 feet above the ground, composed of mature apterous females of the hibernating series, besides numbers of young larvæ deposited by them which had settled near by while others were still crawling about. These young larvæ form the third generation of descendants from migrants of the previous spring.

June 12, 1908.—Numbers of colonies of the hibernating series, each colony being about one-half an inch in length, were seen at Great Falls, Va., on small shrubs. They were about 10 inches above the ground, whereas those on taller trees had located 10 to 25 feet above the ground. All of them were already in the third stage, were closely packed, and covered with a fuzzy secretion. Migrants from maples were not present.

September 24, 1908.—Numerous colonies of this species were again observed on alders near Somerset, Md. Some of the colonies were more than 6 inches in length and were stationed from near the ground to 2 feet above. They were composed of apterous females, numerous larvæ of the hibernating series, pupæ, and some return migrants, while at the same time a considerable number of these return migrants and many of the sexual generation were found on the trunks of maples along a street near by.

October 15, 1908.—Examined some tall alders near Rosslyn, Va., on which migrants from maples had settled in spring, and found four colonies about 10 feet above the ground. These colonies were from 6 to 10 inches long and contained apterous females and numerous larvæ destined for hibernation. They were crawling down the stems to the base, where they congregated in a dense mass, while a great many were already in hiding between the fallen leaves near the base of the trees. There were also many of the return migrants, which were crawling to the tip of the branches or to the terminal leaves, on which they settled, ready for migration.

April 27, 1909.—Examined again the above alders near Rosslyn and found that some specimens of the hibernating series were already in the second and third stages.

In the youngest, or first stage the antennæ are distinctly 4-jointed; in the second stage, after eating a skin, they are 5-jointed; they are also 5-jointed in the third stage, though the divisions between the joints are much more distinct.

June 15, 1909.—Observed some migrants of *Pemphigus acerifolii* and their larvæ on the underside of leaves of alders and numerous colonies of such larvæ on the stems or trunks of such shrubs from 1 to 10 feet above the ground, at Great Falls, Va. (Early in October of the same year large colonies were seen on the same alders, about 4 to 15 feet above the ground, composed of apterous females, accompanied by numerous larvæ of the hibernating series which were swarming down the stems, and numbers of the return migrants.)

June 29, 1910.—Saw again numbers of migrants of *Pemphigus acerifolii*, with recently deposited larvæ near them, on the underside of leaves of alder near Somerset, Md., while numbers of migrants were still flying about. There were also numbers of colonies of apterous females belonging to the hibernating series and numerous larvæ deposited by them.

September 17, 1910.—Numerous colonies of *Pemphigus tessellata*, about 4 feet above the ground, were again found on alders near Somerset. They were composed of apterous females and their larvæ, besides pupæ and return migrants. Many of these colonies were being preyed upon by larvæ of *Feniseeca tarquinius*, as well by larvæ of coccinellid and chrysopid insects. Many of the apterous females descended during October to the base of the shoots or stems, even as far down as 1 or 2 inches below the surface, where they were surrounded by numerous hibernating larvæ, constituting a second series. All of these colonies were covered with tunnels of clay constructed by *Cremastogaster lineolata* Say.

DESCRIPTION OF THE PRINCIPAL STAGES OF PROCIPHILUS TESSELLATA FITCH.

In view of the fact, as has already been stated, that the spring migrants from the maple to the alder and the return fall migrants from the alder to the maple are absolutely identical and, as a rule,

destined to continue and to conclude the yearly cycle of life for the preservation of the species, the following descriptions of some of the principal stages are herewith included.

SEXUAL GENERATION.

The larva-like sexes of the species, which, toward the end of September and early in October, occur on the trunks of maples, are rather small and without a rostrum for the absorption of food.

SEXUAL FEMALE.

The sexual females, as found under loose bark of maple, are of an orange color, with the sides of the body more or less distinctly grayish green. They are elongate-oval and rather plump, and contain only one large orange egg, which reaches to the prothorax. The legs and antennae are whitish: the eyes small and black. The posterior lateral angles of the prothorax and of the first abdominal segment are rather prominent, while similar though smaller angles are also present on all of the other abdominal segments except the terminal one. The antennae are rather short and reach for a short distance beyond the anterior margin of the meso-

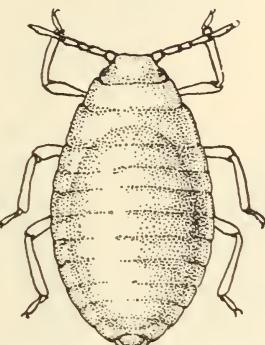
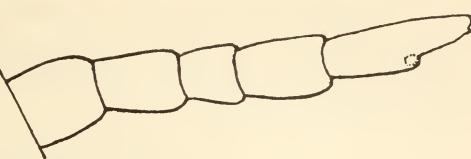


FIG. 3.—*Prociphilus tessellata*: Sexual female and antenna. (Original.)

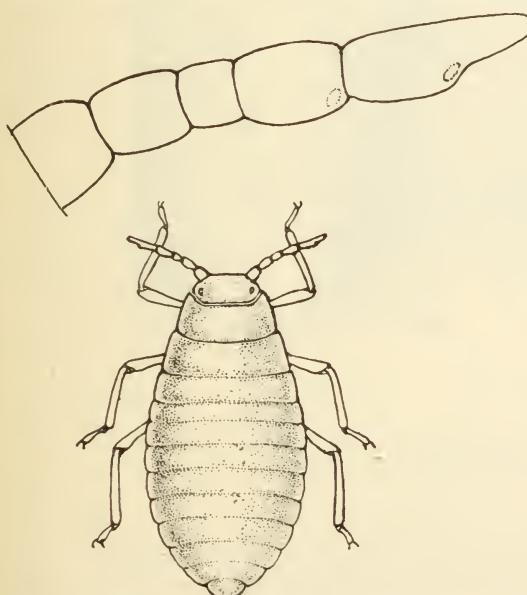


FIG. 4.—*Prociphilus tessellata*: Male and antenna. (Original.)

thorax; they are 5-jointed; joint 3 is shortest and joint 5 longest, or about as long as joints 3 and 4 combined; joints 1, 2, and 4 are somewhat longer than 3, but shorter than 5, and subequal in length. All of the tarsi of both sexes are provided with short, capitate digitules. Length, about 1.2 mm.



FIG. 5.—*Prociphilus tessellata*: Colony on leaf of maple.
(Original.)

MALE.

The male is of a more or less greenish color, with its antennae and legs somewhat dusky. It is rather small and about one-third or less the size of the female. The antennae are about as long as those of the female, though stouter, while the proportion of the length of the various joints is the same in both sexes. Length, about 0.8 mm.

WINTER EGG.

The winter eggs, especially in the vicinity of Washington, D. C., are generally deposited during the first half of October, in cracks and under loose bark of the trunks of silver or soft maples, where they are embedded in delicate white wool. They are highly polished and at first of an orange color, with a greenish-gray central spot, though they change gradually to a blackish green. They are elongate-oval and almost twice as long as wide. Their length is about 0.7 mm., and the diameter 0.4 mm.

ASEXUAL GENERATIONS.

COLONY ON LEAF OF MAPLE.

As had been stated before, it has been demonstrated that the infested leaves on maple trees exhibit a more or less distinct tendency to fold or to double downward, so as to protect the insects within this fold, in which frequently there is a large and closely packed colony of aphides, covered with a cottony secretion which gives the entire mass a resemblance to a large white-haired caterpillar.

YOUNG STEM-MOTHER.

The general color of the young stem-mother is a dull blackish or brownish green, the head being darkest. The eyes are black and the antennae and legs dusky. The insects are covered with a delicate bluish-white secretion, and ornamented with four dorsal and a lateral row each side of whitish cottony knobs. The antennae are 4-jointed and do not reach to the mesothorax; the two basal joints are shortest; joints 3 and 4 are longest and subequal in length, each being about as long as the two basal joints combined; the third is somewhat stoutest at the apex, while the fourth, including its short, blunt spur, appears to be more or less distinctly fusiform. The rostrum is large, and reaches almost to the tip of the abdomen. Length about 0.7 mm.

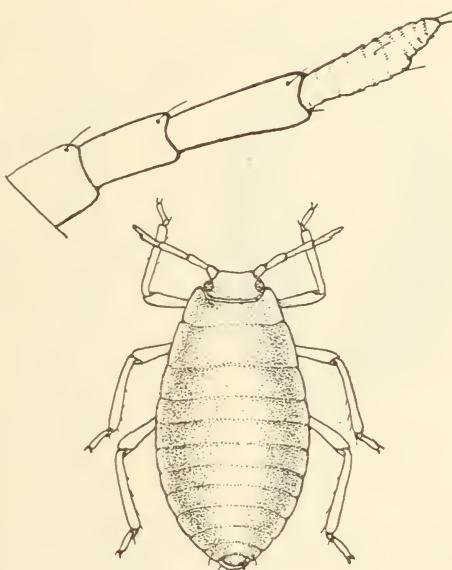


FIG. 6.—*Prociphilus tessellata*: Young stem-mother and antenna. (Original.)

MATURE STEM-MOTHER.

The mature stem-mother, as seen on the leaves of the maple, is densely covered with white wool, which is interspersed with long, stout, white, and wavy strands. This secretion hides the insects completely from view, in consequence of which they resemble small flakes of cotton. Their natural color is dark yellowish green or olive; the end of the body is black; the legs are of the color of the body, with the apex of the femora and tarsi blackish. The antennæ, including the indistinct spur of the terminal joint, are 5-jointed; they are rather short and reach about to the mesothorax. The first joint is stoutest and slightly the shortest; it is about as long as wide, with the apex truncated; joints 2 and 4 are somewhat longer than the first and subequal in length; joints 3 and 5 are longest and each of them is almost as long as the two basal joints combined; the four basal joints are of the color of the body, while the fifth is blackish. Length of body about 4 mm.; diameter about 3 mm.

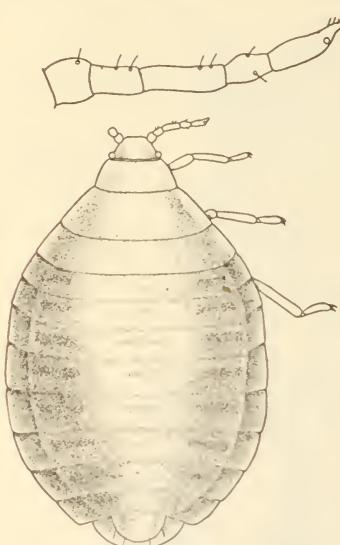


FIG. 7.—*Prociphilus tessellata*:
Mature stem-mother and antenna. (Original.)

genitors of the second series, which has been described, by Dr. Asa Fitch under the name of *Eriosoma tessellata*.

MIGRANT.

The migrant, as well as the return migrant, is rather large and stout. The head with its antennæ, the thorax, and the legs are black. The abdomen is of a greenish-brown or almost black color, being palest on the ventral side. The dorsum of the thorax and of the abdomen is densely covered with a whitish woolly or cottony secretion, which generally projects above the closed wings and beyond the end of the abdomen, while most of the secretion of the head is generally rubbed off. The ventral side is covered with a whitish

powder, which is most dense on the sternum. The antennæ are rather short and reach to or somewhat beyond the insertion of the front wings; they are provided with only a few fine hairs on joints 3 to 5; there are also 9 to 13 annulations on antennal joint 3, 3 to 5 on joints 4 and 5, and from 5 to 7 on joint 6, all of which annulations are more or less indistinct. The tail and last abdominal segment are short and semicircular, surrounded around the edge with slender fine hairs. Nectaries or nectar-pores are absent. The venation of the wings is similar to that of other pemphiginids. Expanse of wings about 12 mm.; length of body about 4 mm.

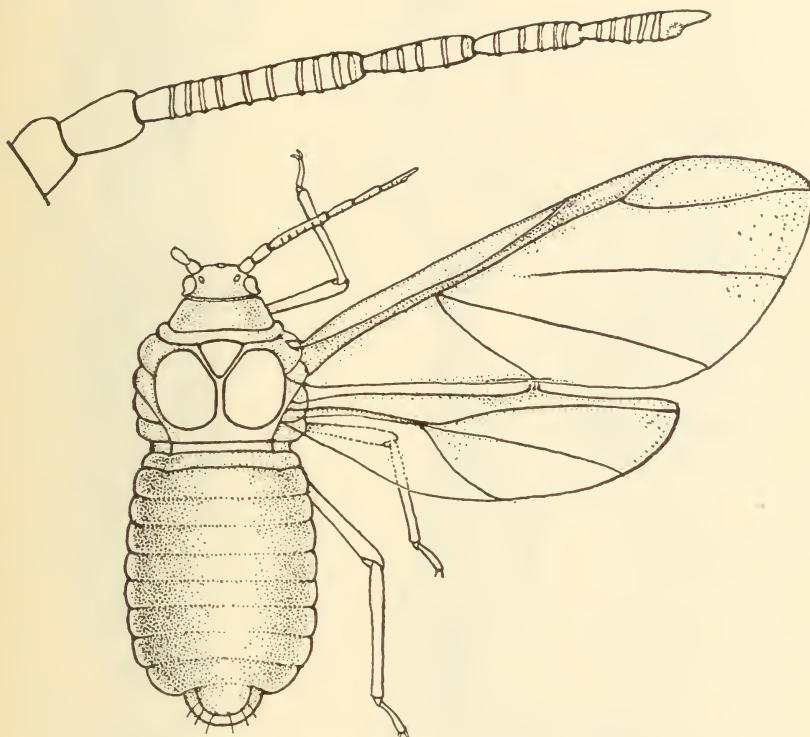


FIG. 8.—*Prociphilus tessellata*: Migrant and antenna. (Original.)

APTEROUS FEMALE ON ALDER.

The apterous females, as found on the stems of alder, are densely covered with white woolly or cottony secretion, which gradually covers a whole colony, though frequently hidden from view by a covering of earth erected over them by *Cremastogaster* and other ants. After having been denuded of their cottony secretion they are found to be of a reddish or dark orange-brown color, with the divisions between the abdominal segments much darker or almost

black; the antennæ and legs are the color of the body and the tarsi are blackish. The antennæ are 6-jointed, rather short, and reach at most to the middle of the mesothorax. Antennal joints 3 and 6 are longest and subequal in length, each being about as long as joints 4 and 5 combined; joints 1, 2, 4, and 5 are shortest and subequal in length, with the two basal joints, as usual, stoutest; all of the joints

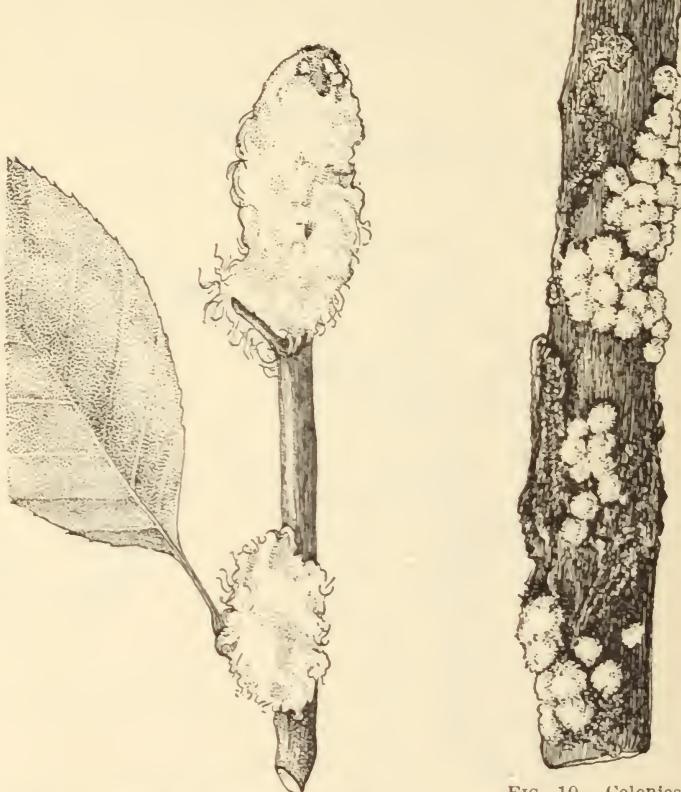


FIG. 9.—Colonies of apterous females on alder. (Original.)

FIG. 10.—Colonies of apterous females on alder. (Original.)

are provided with a few fine and short hairs. The tail and last abdominal segment are as in the migrant. Length about 3 mm.

HIBERNATING SERIES.

The hibernating larvæ, as well as those deposited by migrants and apterous females, are of an orange color, with the eyes and tarsi dark brown or black; all of them are covered with a short and shaggy secretion. The antennæ are 4-jointed in all of them; they are short, as usual, and reach to nearly the middle of the mesothorax.

The first joint is shortest, stoutest at the apex, and about one-half the length of the second; joint 3 is longest, rather slender, though somewhat stoutest at the apex; joint 4 is next in length and about twice as long as the second. The rostrum is almost as long as the body. Length about 1 mm.

ECONOMIC STATUS.

This species may not be considered as particularly injurious, though

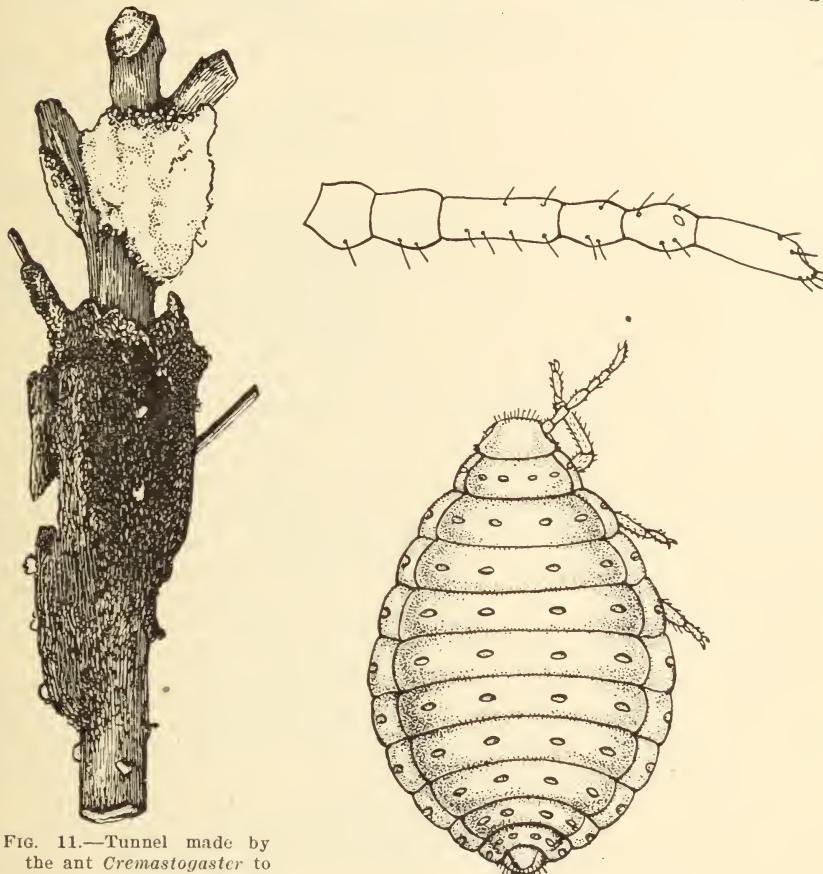


FIG. 11.—Tunnel made by the ant *Cremastogaster* to protect colony of *Prociphilus tessellata* on alder. (Original.)

FIG. 12.—*Prociphilus tessellata*: Apterous female and antenna. (Original.)

it may occasionally become quite annoying if present in numerous colonies on the leaves of maple trees, in consequence of which it may be advisable to suggest some method for keeping it down, if not actually exterminating it, in certain localities. To accomplish this result it is advisable to cut down all of the shrubs of alder during the spring and fall to near the surface of the ground and to burn all of the bush as soon as possible, in order to destroy all of the

colonies as a measure to prevent the maturing of the return migrants. Still later in the season it is advisable to spray all of the remaining stumps of the shrubs, as well as the accumulated dry leaves and other débris surrounding them, with a dilute solution of kerosene emulsion, in order to destroy the hibernating larvæ. If these shrubs are kept down for a few years there will be no chance for the migrants from maples to deposit their larvæ and consequently no return migrants to fly back to the trunks of maple trees.

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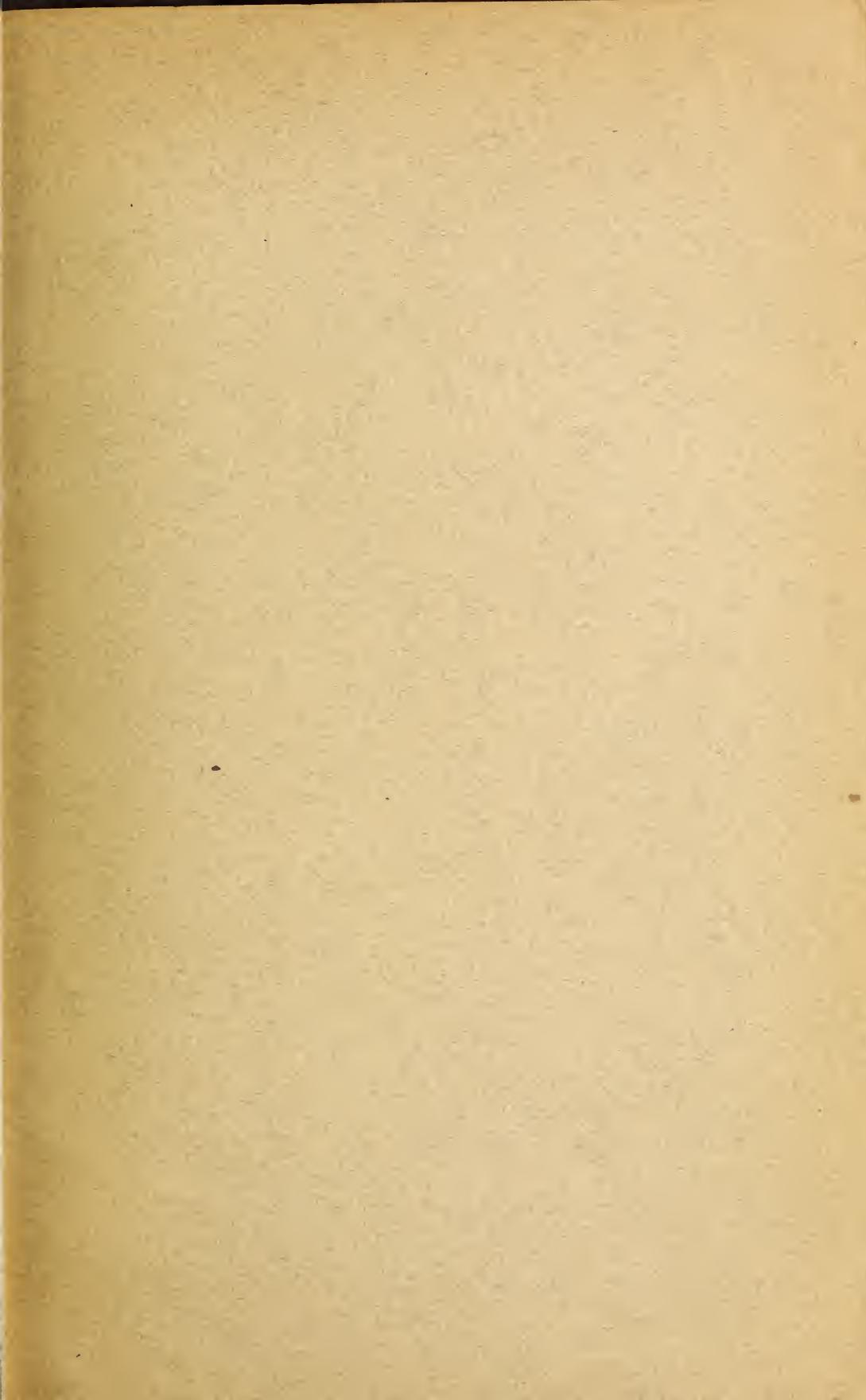
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